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Mini-laparotomy cholecystectomy: Technique, outcomes: A prospective study

Alexander M. Shulutko, Airazat M. Kazaryan, Vadim G. Agadzhanov*

Department of Faculty Surgery N 2, I.M. Sechenov Moscow Medical Academy, Moscow, Russia

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ABSTRACT

Background: The last decades have been characterized by a rapid growth in minimally invasive techniques for acute and chronic cholecystitis. The aim of our study was to analyze 10 years of experience with the mini-laparotomy cholecystectomy.

Methods: From 1994 to 2004, we performed 2295 mini-laparotomy cholecystectomies, including 1028 patients with acute and 1267 patients with chronic cholecystitis. There were 1780 women and 515 men. We utilized a special surgical tool kit with a system of circular and small hook-retractors incorporating an illuminator and long surgical instruments. Our surgical approach was carried out using a 3–5 cm longitudinal incision located immediately above the gallbladder with a muscle splitting technique.

Results: The mean time of operation was 64.5 ± 24.5 min and the conversion rate was 3.7%. Intraoperative complications occurred in 25 cases (1.1%), including 4 cases (0.17%) of biliary tract injury. Cholecystectomy was combined with intervention on the choledochus and the papilla of Vater in 133 patients with choledocholithiasis. Postoperative complications developed in 4.1%. Five hundred and five patients (22%) required opioid analgesics on the first postoperative day. The mortality rate was 0.17%. The mortalities involved patients who had severe concomitant diseases and required urgent surgery for acute cholecystitis. Patients operated for acute cholecystitis had significantly higher rates of postoperative complications (5.8% vs. 2.8%), need for opioids (25.5% vs. 19.2%) and mortality (0.39% vs. 0%).

Conclusions: Mini-laparotomy cholecystectomy is an alternative to laparoscopic approach in the surgical treatment of acute and chronic cholecystitis.

1. Introduction

Cholecystectomy is one of the most common operations performed by departments of general or gastro-intestinal surgery. The last decades have been characterized by a growth in minimally invasive techniques for surgical management of acute and chronic cholecystitis. The main principles of minimally invasive surgery were established by D.O. Ott and G. Kelling in the beginning of the last century.[1,2] However, due to technical limitations these principles were only widely introduced in clinical practice starting in the 1980s. Laparoscopic and mini-laparotomy cholecystectomy are widely recognized minimally invasive operations.

2. Material and methods

The data of 2295 patients operated through mini-laparotomy from 1994 to 2004 for acute or chronic cholecystitis in the Clinic of Faculty Surgery No. 2 of I.M. Sechenov Moscow Medical Academy affiliated with Moscow City Clinical Hospital N61 were prospectively collected. One thousand and

* *Corresponding author*. Interventional Centre, Rikshospitalet University Hospital, 0027, Oslo, Norway. Tel.: +47 23 07 01 18; fax: +47 23 07 01 10.
E-mail address: airazat.kazaryan@rikshospitalet.no (A.M. Kazaryan).

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twenty-eight patients had the surgery for acute cholecystitis and 1267 for chronic cholecystitis. Among the operated patients there were 1780 women and 515 men. The mean age ± standard deviation of the patients was 57.3 ± 15.2 years (range 16–92). Patients with biliary malignancies were excluded from the study.

Patients had a standard preoperative work up including ultrasonography. Endoscopic retrograde cholangiopancreatography was performed in all patients with suspected biliary obstruction on ultrasonography or biochemical blood analysis, but who did not require emergent surgery. Papillosphincterotomy was performed in documented choledocholithiasis or duodenal papilla stricture as the first treatment. Patients with acute cholecystitis received antibiotics preoperatively. The majority of patients with acute cholecystitis were operated within 24 h after admission to the hospital.

The operations were carried out under general anesthesia with muscle relaxants. Intraoperative prophylactic antibiotics were prescribed in all cases (mainly cefotaxime 1000–2000 mg/ceftriaxone 1000–2000 mg/cefuroxime 750–1500 mg either alone or in combination with metronidazole 500 mg). We utilized a special surgical tool kit of the series ''Mini-assistant'' designed by the company Liga-7 (Ekaterinburg, Russia) (Fig. 1). The operation utilized a mini-laparotomy approach with techniques of distant operative manipulations. In the majority of cases, neither the surgeon's hand nor even his finger entered the abdominal cavity.

A 3 to 5 cm longitudinal incision was performed starting 4 cm lateral to the midline at the subcostal margin. Using sharp dissection, the skin, subcutaneous fat, anterior rectus sheaths were opened followed by muscle splitting. The peritoneum was incised with the posterior rectus sheath. It is crucial to enter the peritoneal cavity to the right of the falciform.

We then proceeded to set up the retractors and illumination. First two small retractors were placed in a direction perpendicular to the incision. The primary aim of these retractors was to extend the wound laterally to fix the circular retractor. The right retractor should be directed in a sloping position to allow for gallbladder retraction. The left retractor was routinely positioned directly opposite. A major lap pad was placed in the subhepatic space. The third upper retractor had an illuminator that was connected to a fiberoptic light source. This retractor was placed in the upper part of the incision. It also served as a hepatic retractor (Fig. 2). In some cases it was enough to have three retractors. Quite often we had to use a fourth lower retractor which was longer and was positioned non-fixed at the inferior edge of the wound. It was placed together with a lap pad in the required position and fixed. Lap pads were positioned between retractors. In order to mark the lap pads, we connected them to a long thick-thread ligature with a forceps on the tips. Lap pads were inserted into abdominal cavity and positioned between the retractors: on the left—under the left hepatic lobe; on the left and downward—for retraction of the stomach and greater omentum; on the right and downward—for fixation of the right colonic flexure and loops of small bowel. Three or four retractors and lap pads were usually sufficient for operative exposure and isolation of the operative field from the rest of abdominal cavity. A fifth retractor was sometimes required in difficult cases.

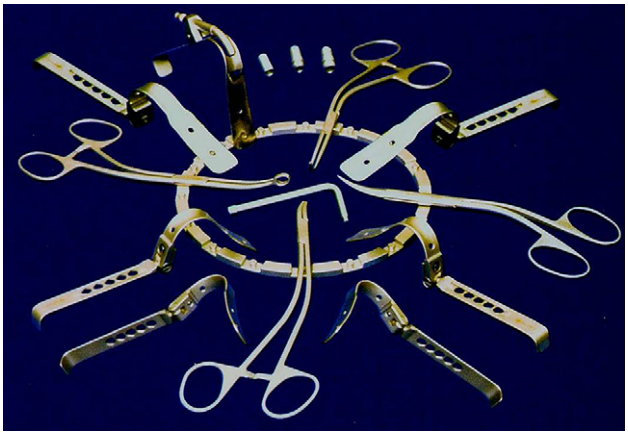

Fig. 1 – Surgical tool kit ''Mini-assistant'' for mini-laparotomy cholecystectomy.

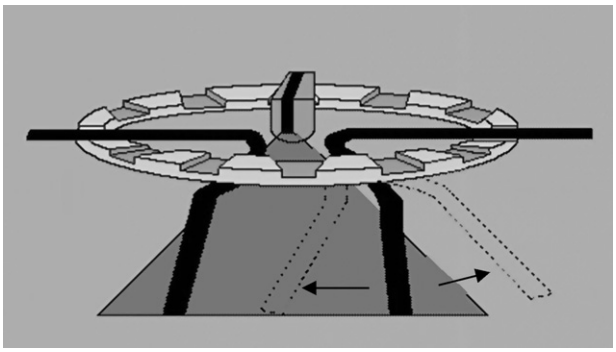

Fig. 2 – Schema of retractor positioning and working space after their installation.

The surgeon can clearly see the inferior surface of the liver and gallbladder after a proper setup. Dissection of the structures in the triangle of Calot did not differ from the traditional open technique other than the necessity of remote operating and the inability to place the whole hand into the abdomen. The instruments have an angular displacement of the working part to the handhold to prevent obstruction of the operative field by the surgeon's hand. In operations for acute cholecystitis the gallbladder was aspirated.

After dissection of the cystic duct, cholangiography or choledochoscopy could be performed via the cystic duct utilizing a special cannulating instrument that is part of the ''Mini-assistant'' tool kit. The cystic duct was subsequently transected using double ligatures. The knot was created by the assistance of a special stick-fork: a knot was formed outside of the abdomen, then it was pushed down and tightened by means of a special fork (see Fig. 3). This was followed by ligation of the cystic artery (clips could be used too).

It is crucial to get into the proper plane to separate the gallbladder from the gallbladder fossa in order to avoid dissection into the liver with resultant bleeding. Scissors or electrocautery were used. The gallbladder retrieval via the mini-laparotomy incision usually did not present any problem. We routinely utilized a self-suction drain in the gallbladder fossa.

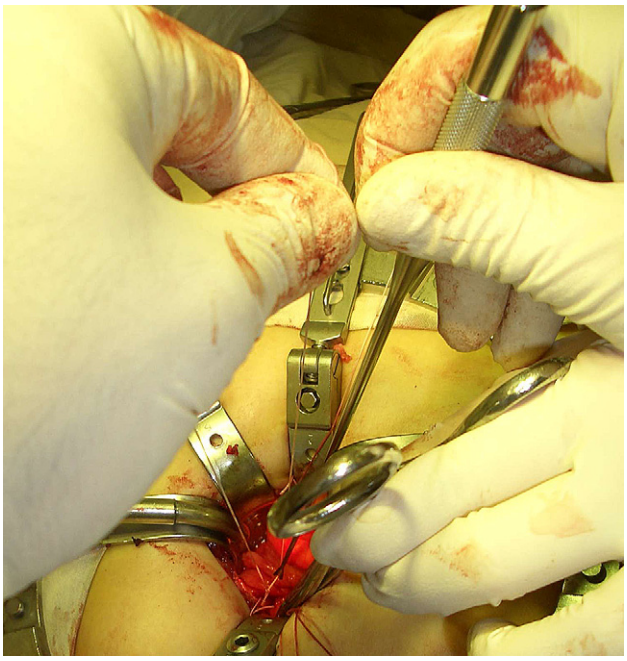

Fig. 3 – Ligation of cystic duct with application of a special fork.

Almost all patients with acute cholecystitis and some patients with chronic cholecystitis received antibiotics postoperatively (mainly cephalosporins). The median duration of postoperative antibiotic treatment was 5 days. In the last few years there was a trend to shorten the antibiotic to a single intraoperative injection for patients with chronic and mild acute cholecystitis. Pain relief was by nonsteroid anti-inflammatory drugs (mainly intramuscular metamizole sodium 500 mg, 3 times per day or ketorolac 20 mg, 3 times per day). In a few cases opioid analgesics were given on the first postoperative day (mainly intramuscular trimeperidine 10 mg, single use, in rare cases repeated injections in 6–12 h). The drain was removed in 2 to 3 days, depending on the amount of drainage.

The data were presented as median, mean and standard deviation. For comparison of frequencies the Fisher exact test, and for analysis of continuous variables the Student *t*-test, were used.

3. Results

Mini-laparotomy cholecystectomy was successful in 96.3%. Conversion to a traditional laparotomy was required in 84 cases representing 3.7% (4.8% in acute and 2.8% in chronic cholecystitis) (Table 1). The cause of conversions in 21 cases was bleeding from the gallbladder fossa or from the cystic artery. In two cases partial injury of the common hepatic duct occurred during manipulations in the presence of marked inflammation in the gallbladder neck and in the hepatoduodenal ligament. In one case conversion to laparotomy was required for repair of the ductal injury, in another case the injured structure was sutured without conversion. In one case with complete transection of the common hepatic duct, conversion to laparotomy and Roux hepaticoenterostomy were done. In a case with electrocautery injury of the left hepatic duct (without perforation) the injury was unnoticed during the operation with choledochoduodenostomy. This patient required two surgeries for recurrent cholangitis. At the first re-exploration we noted a left hepatic duct injury requiring choledochotomy and T-tube drainage. Due to the patient's worsening course, a second re-exploration was required and it revealed a leaking choledochoduodenostomy. The anastomosis was taken down and a choledochojejunostomy was performed. The patient was subsequently discharged home in a satisfactory condition. The other 63 conversions were carried out because of considerable technical difficulties. These occurred in patients with bilio-biliary and bilio-enteric fistulas, Mirizzi syndrome, fibrotic and inflammatory changes around the hepatoduodenal ligament. The intraoperative complication rate was 1.1%, including 0.17% biliary tract injuries (Table 1).

Cholecystectomy was combined with procedures on the choledochus and the papilla of Vater in 133 patients with choledocholithiasis. Choledocholithiasis was treated with choledochoduodenostomy in 56 cases, T-tube drainage in 36 cases, exploration followed by primary closure of choledochotomy in 33 cases, transcystic choledochoscopy with extraction of common bile duct stones in 8 cases, and duodenotomy in 2 cases (to extract a large stone impacted in the papilla in 1 case and to remove a large adenoma of the papilla in another case). These latter cases involved the placement of a T-tube.

Table 1 – Per- and postoperative data

Parameters	Acute cholecystitis ($n = 1028$)	Chronic cholecystitis ($n = 1267$)	P value	Total ($N = 2295$)
Conversions	49 (4.8%)	35 (2.8%)	0.014*	84 (3.7%)
Mean operative time (min)	66.8 ± 25.7	62.6 ± 23.3	<0.01**	64.5 ± 24.5
Intraoperative complications	13 (1.3%)	12 (0.95%)	0.546*	25 (1.1%)
Biliary tract injury	1 (0.1%)	3 (0.24%)	0.633*	4 (0.17%)
Simultaneous hernia repair	12 (1.2%)	33 (2.6%)	0.015*	45 (2.0%)
Postoperative complications	60 (5.8%)	35 (2.8%)	0.02*	95 (4.1%)
Postoperative demand of opioid analgesics	262 (25.5%)	243 (19.2%)	<0.001*	505 (22%)
Mortality	4 (0.39%)	0	0.04*	4 (0.17%)

*Fisher test; **Student test.

Table 2 – Interventions on common bile duct

Parameters	Acute cholecystitis ($n = 1028$)	Chronic cholecystitis ($n = 1267$)	P value	Total ($N = 2295$)
Choledochoduodenostomy	20 (1.9%)	35 (2.8%)	0.33*	56 (2.4%)
T-tube drainage	22 (2.1%)	12 (0.9%)	0.023*	36 (1.6%)
Primary closure of choledochotomy	5 (0.5%)	27 (2.1%)	<0.001*	33 (1.4%)
Transcystic choledochoscopy with extraction of common bile duct stones	3 (0.3%)	9 (0.7%)	0.25*	12 (0.5%)
Total number of interventions on the common bile duct	50 (5.0%)	83 (6.5%)	0.088*	133 (5.8%)

*Fisher test.

The rate of interventions on the common bile duct did not differ statistically between acute and chronic cholecystitis, but acute cholecystitis was associated with a significantly higher rate of T-tube drainage and chronic cholecystitis with primary closure of choledochotomy (Table 2).

During mini-laparotomy cholecystectomy takedown of cholecystic fistulas was performed in 8 patients (cholecysto-duodenal in 4 cases, cholecysto-choledochal in 3 cases, and cholecysto-colonic in 1 case).

Simultaneous hernia repair was performed in 45 cases (2%); it was done significantly more frequently in chronic cholecystitis (Table 1).

The mean operative time was 64.5 ± 24.5 min. A statistically significant difference in operative time was found between acute and chronic cholecystitis (66.8 ± 25.7 min and 62.6 ± 23.3 min, respectively). The rate of conversion was significantly higher in acute cholecystitis while the frequency of complications did not differ statistically between acute and chronic cholecystitis (Table 1).

Only 22% of patients required opioid analgesics on the first postoperative day. The main medication for pain was with nonsteroid anti-inflammatory drugs for a median of 2 postoperative days. The majority of patients were able to resume activity on the first postoperative day.

Patients with acute cholecystitis demanded opioids significantly more often than those with chronic cholecystitis (Table 1).

The absence of postoperative ileus allowed the majority of patients to start on a diet on postoperative day 1.

Postoperative complications were observed in 95 (4.1%) patients including 36 local complications. Local complications were mainly seromas and hematomas of the incision. Other local complications were 3 cases of breakage of drain and 3 cases of evisceration. In 2 cases, re-exploration was performed to deal with the broken drain. In one case the drain broke 3 days after the operation. The drain was removed utilizing laparoscopy. In two cases re-laparotomy was performed with disconnection of the choledochoduodenal anastomosis and T-tube drainage.

Regarding general complications, there were 6 episodes of gastrointestinal bleeding. Pulmonary (pneumonia, atelectasis) and cardiac (myocardial infarction) complications were more common in acute cholecystitis (15 pneumonias/atelectases, 4 myocardial infarctions in the acute cholecystitis group versus 5 pneumonias/atelectases, 1 myocardial infarction in the chronic cholecystitis group).

Four patients died in the early postoperative period (pulmonary embolism in 2 patients, myocardial infarction in 1 patient, acute cardiopulmonary failure in 1 patient). All these patients received urgent surgery for acute cholecystitis.

4. Discussion

Mini-laparotomy cholecystectomy produces "minimal trauma", and we believe that it has a similar level of invasiveness to the laparoscopic approach.[3–11] The technique of mini-laparotomy cholecystectomy with modifications has been described by several authors.[12–17] The main specific feature of our approach is the use of a longitudinal rectus muscle splitting incision over the gallbladder, as opposed to a subcostal or longitudinal midline incision used by other surgeons.[15,18–22] This approach allows us to reduce the probability of damaging subcutaneous sensory nerves which run in a longitudinal direction. The other advantage is it uses a muscle splitting approach as opposed to the muscle transecting technique in the subcostal approach. The longitudinal incision through the rectus muscle avoids transection of the linea alba. It potentially reduces the possibility of postoperative hernia development.

The low mortality rate in our series and in the surgical literature leads us to conclude that mini-laparotomy and video-laparoscopic operations can be carried out even in elderly people.[20,23] The considerably less trauma in comparison with the standard open cholecystectomy makes it possible to perform this operation in one stage in the majority of elderly patients. Our experience showed that even in patients older than 75 years (9.1% in our series) the operation was well tolerated.

Damage of bile duct occurred in 4 patients (0.17%), comparable to the rate of injury in open laparotomy and laparoscopic cholecystectomy.[24–26]

Conversion to a laparotomy is more likely in acute cholecystitis than chronic cholecystitis. We had to convert 2.8% in chronic cholecystitis and 4.8% in acute cholecystitis. Our experience led us to follow the routine that if after 30 min the structures of the Calot triangle were not identified, another surgeon experienced in this operation was called, and a joint decision was made concerning conversion to laparotomy. With such a policy our rate of conversion may be a little higher but it ultimately leads to a lower risk of bile duct injury. A similar policy is also used by some surgeons who perform laparoscopic cholecystectomy.[27]

Fig. 4 – Patient's wound on the 10th postoperative day.

In 133 cases, an additional procedure on the choledochus was added to the cholecystectomy. There were no major technical problems.

The postoperative period was smooth in the majority of patients. Good cosmetic results were achieved (Fig. 4). The postoperative complications and mortality were significantly higher for acute cholecystitis than chronic cholecystitis.

In the majority of cases, either mini-laparotomy or laparoscopic cholecystectomy can be used. However in some cases, mini-laparotomy may be the preferred treatment. As intra-abdominal adhesions could make the laparoscopic approach technically difficult, patients with previous abdominal surgery should receive mini-laparotomic cholecystectomy. The inability to perform a full survey of the peritoneal cavity is a major drawback of the mini-laparotomic approach. However modern progress in preoperative diagnostic imaging essentially diminishes the significance of this drawback.

A decrease in the length of hospital stay decreases the cost for the mini-laparotomy cholecystectomy when compared with traditional open cholecystectomy.[28,29] All surgical instruments used in mini-laparotomy are reusable. They are simple and do not require extra expenses for maintenance (compared with CO_2 insufflation system and video system) in laparoscopic cholecystectomy. As the hospital stay is the same for the two operations, mini-laparotomy cholecystectomy is cheaper than laparoscopic cholecystectomy.[30–33] This is especially important in poor countries.

The benefits of the mini-laparotomy over the laparoscopic approach include: (1) absence of pneumoperitoneum; (2) absence of problems associated with specimen removal; (3) operative technique similar to a standard open procedure—additional procedures on the choledochus can be easily added; (4) complete isolation of the operative field from the rest of the abdomen (important in acute cholecystitis); (5) can be used in patients with previous abdominal surgery.

Nevertheless, mini-laparotomy cholecystectomy is not appropriate for some patients. Obese patients are not good candidates for mini-laparotomy cholecystectomy. They should receive laparoscopic cholecystectomy. Also, the laparoscopic approach provides better cosmetic outcomes especially in patients who are prone to dystrophic scar formation. For patients whose concern in cosmesis is of crucial importance (young women), laparoscopic cholecystectomy may be a better option.

Thus, mini-laparotomy cholecystectomy is a minimally invasive operation, which is well tolerated, and is associated with minimal complications and conversions. When it is carried out with the surgical tool kit ''Mini-assistant'', it is an alternative to videolaparoscopic cholecystectomy for acute and chronic cholecystitis.

Conflict of interest

The authors state that there is no conflict of interest.

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Ethical approval

The study was approved by the Research Committee of the Academic Council of I.M. Sechenov Moscow Medical Academy (reference number GR01970007142).

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Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ijsu.2007.07.004.

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